Appendix A: Answers to Selected Problems

Ch 1: Units and Problem Solving

1a. A person of height 5 ft. 11 in. is 1.80 m tall
1b. The same person is 180 cm
2a. 3 seconds = 1/1200 hours
2b. $3\text{x}10^3$ ms
3. 87.5 mi/hr
4c. if the person weighs 150 lb. this is equivalent to 668 N
5. Pascals (Pa), which equals N/m^2
6. 168 lb., 76.2 kg
7. 5 mi/hr/s
8. 15.13 m
9. 11.85 m
10. 89,300 mm
11. 2025 mm^2
12. 196 cm^2
13. 250 cm^3
14. 8:1, each side goes up by 2 cm, so it will change by 2^3
15. 3.5×10^{51}:1
16. 72,000 km/h
17. 0.75 kg/s
18. 8 x 2^N cm^3/sec; *N* is for each second starting with 0 seconds for 8 cm^3
19. About 12 million
20. About 1½ trillion (1.5×10^{12})
21. [a] = N/kg = m/s^2

Ch 2: Energy Conservation

1. d
2. (discuss in class)
3a. 5.0 x 10^5 J
3b. 3.7 x 10^5 J
3c. Chemical bonds in the food.
3d. 99 m/s
4a. 5.0 x 10^5 J
4b. 108 m/s
5a. 450,000 J
5b. 22,500 J
5c. 5,625 J
5d. 21.2 m/s
5e. 9.18 m
7b. KE = 504,600 J; U_g = 1,058,400 J; E_{total} = 1,563,000 J
8a. 34 m/s at B; 28 m/s at D, 40 m/s at E, 49 m/s at C and F; 0 m/s at H
8b. 96 m
9a. 1.7 J
9b. 1.3 m/s
9c. 0.4 J, 0.63 m/s
10a. 1.2 m/s^2
10b. 130 J
11a. 6750 J
11b. $2.25\text{x}10^5$ J
11c. $1.5\text{x}10^5$ J/gallon of gas
12. 0.76 m

Ch 3: One-Dimensional Motion (answers assume 9.8 m/s² for acceleration of gravity)

2. b
3. a,c,d
4. a,d
5a. Zyan
5b. Ashaan is accelerating because the distance he travels every 0.1 seconds is increasing, so the speed must be increasing
5c. Ashaan
5d. Zyan
5f. Ashaan
8. 6 minutes
9d. 20 meters
9e. 40 meters
9f. 2.67 m/s
9g. 6 m/s
9h. Between t = 15 s and t = 20 sec because your position goes from x = 30 m to x = 20 m.
9i. You made some sort of turn
10a. 7.7 m/s^2
10b. 47 m, 150 feet
10c. 34 m/s
11a. 1.22 m
11b. 4.9 m/s
11c. 2.46 m/s

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11d. -4.9 m/s
12b. 1 second
12c. at 2 seconds
12d. 4m
13a. 250 m
13b. 13 m/s, -13m/s
13c. 14s for round trip
14. 6 times higher
15. $-31 m/s^2$
16a. 23 m/s
16b. 3.6 seconds
16c. 28 m
16d. 45m
17a. 25 m/s
17b. 30 m
17c. $2.5 m/s^2$
18. $2 m/s^2$
19a. $v_0 = 0$
19b. $10 m/s^2$
19c. $-10 m/s^2$
19d. 60 m
20a. $0.3 m/s^2$
20b. 0.5 m/s

Ch 4: Two-Dimensional and Projectile Motion

7a. 13 m
7b. 41 degrees
7c. $v_y = 26$ m/s; $v_x = 45$ m/s
7d. 56 degrees, 14 m/s
9. 32 m
10a. 0.5 s
10b. 0.8 m/s
11. 104 m
12. $t = 0.60$ s, 1.8 m below target
13. 28 m.
14a. 3.5 s.
14b. 35 m; 15 m
15. 40 m; 8.5 m
16. 1.3 seconds, 7.1 meters
17. 50 m; $v_{0y} = 30$ m/s; 50^0; on the way up
18. 4.4 s
19. 19^o
20. 0.5 s
21. 2.3 m/s
22. 6 m
23. 1.4 seconds
24a. yes
24b. 18 m/s @ -46 degrees from horizontal
25. 22 m/s @ 62 degrees

Ch 5: Newton's Laws

4. Zero; weight of the hammer minus the air resistance.
5. 2 forces
6. 1 force
7. No
8. The towel's inertia resists the acceleration
9a. Same distance
9b. You go farther
9c. Same amount of force
11a. 98 N
11b. 98 N
13. 32 N
14. $5.7 m/s^2$
17. $F_x = 14$ N, $F_y = 20$ N
18. Left picture: F = 23N 98°, right picture: F = 54 N 5°
19. $3 m/s^2$ east
20. $4 m/s^2$; 22.5° NE
21. 0.51
22. 0.2
23. The rope will not break because his weight of 784 N is distributed between the two ropes.
24. Yes, because his weight of 784 N is greater than what the rope can hold.
25. Mass is 51 kg and weight is 82 N
26a. While accelerating down
26b. 686 N
26c. 826 N
27a. 390 N
27b. 490 N
28. 0.33
29. 3.6 kg
30. $g\sin\theta$
31b. 20 N
31c. 4.9 N
31d. 1.63 kg
31e. Eraser would slip down the wall
32a. 1450 N
32b. 5600 N
32c. 5700 N
32d. Friction between the tires and the ground
32e. Fuel, engine, or equal and opposite reaction
33b. 210 N
33c. no, the box is flat so the normal force doesn't change
33d. $2.8 m/s^2$

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33e. 28 m/s
33f. no
33g. 69 N
33h 57 N
33i 40 N
33j 0.33
33k 0.09
35a. zero
35b. $-kx_0$
36b. $f_1 = \mu_k m_1 g\cos\theta$; $f_2 = \mu_k m_2 g\cos\theta$
36c. Ma
36d $T_A = (m_1 + m_2)(a + \mu\cos\theta)$ and $T_B = m_2 a + \mu m_2\cos\theta$
36e. Solve by using $d = 1/2at^2$ and substituting h for d
37a. Yes, because it is static and you know the angle and m_1
37b. Yes, T_A and the angle gives you m_1 and the angle and T_C gives you m_2, $m_1 = T_A\cos25/g$ and $m_2 = T_C\cos30/g$
38a. 3 seconds
38d. 90 m
42a. 1.5 N; 2.1 N; 0.71

Ch 6: Centripetal Forces

5a. 100 N
5b $10\ m/s^2$
6a. 25 N towards her
6b. 25 N towards you
7a. $14.2\ m/s^2$
7b. $7.1\text{x}10^3$ N
7c. friction between the tires and the road
8. .0034g
9a. $6.2\text{x}10^5 m/s^2$
9b. The same as a.
10. 3.56×10^{22} N
11. 4.2×10^{-7} N; very small force
12. $g = 9.8\ m/s^2$; you'll get close to this number but not exactly due to some other small effects
13a. 4×10^{26} N
13b. gravity
13c. 2×10^{41} kg
14. $.006\ m/s^2$
15a. .765
15b. 4880 N
16a. $\sim 10^{-8}$ N very small force
16b. Your pencil does not accelerate toward you because the frictional force on your pencil is much greater than this force.
17a. 4.23×10^7 m
17b. 6.6 R_e
17d. The same, the radius is independent of mass
18. 1.9×10^7m
19. You get two answers for *r*, one is outside of the two stars one is between them, that's the one you want, 1.32×10^{10} m from the larger star.
22a. v = 28m/s
22b. v-down, a-right
22c. f-right
22d. Yes, 640N

Ch 7: Momentum Conservation

8. 37.5 m/s
9. $v_1 = 2v_2$
10a. $24\ \frac{kg\cdot m}{s}$
10b. 0.364 m/s
10c. $22\ \frac{kg\cdot m}{s}$
10d. 109 N
10e. 109 N due to Newton's third law
11. 2.0 kg, 125 m/s
12. 21 m/s to the left
13. 3250 N
14a. 90 sec
14b. 1.7×10^5 sec
15a. 60 m/s
15b. .700 sec
15c. yes, 8.16 m
16. 0.13 m/s to the left
17a. 11000 N to the left
17b. tree experienced same average force of 11000 N but to the right
17c. 2500 lb.
17d. about 2.5 "g"s of acceleration
18a. no change
18b. the last two cars
19a. 0.0057 s
19b. 2.85 kg
20a. $0.0058\ m/s^2$
20b. $3.5\ m/s^2$
21a. 15 m/s
21b. 49^o S of E

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22b. 4.6 m/s 68°

Ch 8: Energy & Force

6a. 7.18×10^9 J
6b. 204 m/s
7a. 34 m/s @ B; 28 m/s @ D; 40 m/s @ E; 49 m/s @ C and F; 0 m/s @ H
7b. 30 m
7c. Yes, it makes the loop!!
8a. 2.3 m/s
8c. No, the baby will not clear the hill.
9a. 29,500 J
9b. 7.9 m
11a. 86 m
11b. 220 m
12a. 48.5 m/s
12b. 128 N
13. 0.32 m/s each
14a. 10 m/s
14b. 52 m
15a. 1.1×10^4 N/m
15b. 2 m above the spring
16. 96%
18a. .008 m
18b. 5.12°
19. 8 m/s same direction as the cue ball and 0 m/s
20. v_{golf} =-24.5 m/s; v_{pool} = 17.6 m/s
21. 2.8 m
22a. 0.57 m/s
22b. Leonora's
22c. 617 J
23a. 19.8 m/s
23b. 8.8 m/s
23c. 39.5 m
24a. 89 kW
24b. 0.4
24c. 15.1 m/s
25. 43.8 m/s
29a. 3.15×10^5 J
29b. 18.0 m/s
29c. 2.41 m
29d. 7900 J
30a. $v_0/14$
30b. $mv_0^2/8$
30c. $7mv_0^2/392$
30d. 71%

Ch 9: Rotational Motion

2a. 9.74×10^{37} kg m^2
2b. 1.33×10^{47} kg m^2
2c. 0.5 kg m^2
2d. 0.28 kg m^2
2e. 0.07 kg m^2
3 a. True, all rotate 2π for 86,400 sec which is 24 hours,
3b. True, $\omega = 2\pi/t$ and t=86,400 s
3f. True, L is the same
3g. $L = I\omega$ and $I = 2/5\ mr^2$
3h. True, $K = ½\ I\omega^2$ & $I = 2/5\ mr^2$ sub-in $K = 1/5\ mr^2\omega^2$
3i. True, $K = ½\ I\omega^2$ & $I = mr^2$ sub-in $K = 1/2\ mr^2\omega^2$,
4a. 250 rad
4b. 40 rad
4c. 25 rad/s
4d. Force applied perpendicular to radius allows α
4e. 0.27 kg m^2,
4f. K_5 = 84 J and K_{10} = 340 J
6. Moment of inertia at the end $1/3\ ML^2$ at the center $1/12\ ML^2$, angular momentum, $L = I\omega$ and torque, $\tau = I\alpha$ change the in the same way
.8. Lower
9. Iron ball
10a. 200 N team
10b. 40 N
10c. 0.02 rad/s^2
10d. 25 s
11a. Coin with the hole
11b. Coin with the hole
12a. weight
12b. 19.6 N
12c. plank's length (0.8m) left of the pivot
12d. 15.7 N m,
12e Ba. weight, Bb. 14.7 N, Bc. plank's length (0.3m) left of the pivot, Bd. 4.4 N m, Ca. weight, Cb. 13.6 N, Cc. plank's length (1.00 m) right of the pivot, Cd. 13.6 N m, f) 6.5 N m CC, g) no, net torque doesn't equal zero
13a. 7.27×10^{-6} Hz
13b. 7.27 Hz
14.a. 100 Hz
14 b. 1.25×10^5 J

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14c. 2500 J-s
14d. 12,500 m-N
15. 28 rev/sec
16. 2300 N
17b. 771 N, 1030 N
17c. 554 kgm^2
17d. 4.81 rad/sec^2
18a. 300 N
18b. 240N, -22 N
18c. .092
19a. 2280 N
19b. 856 n toward beam, 106 N down
19c. 425 kg m^2
19d. 3.39 rad/sec^2
20a. -1.28 mN
20b. CCW
21a. 1411 kg
21c. 17410 N

Ch 10: Simple Harmonic Motion

1a. Buoyant force and gravity
1b. T = 6 s, *f* = 1/6 Hz
2a. $9.8x10^5$ N/m
2b. 0.5 mm
2c. 22 Hz, no,
3. $3.2x10^3$ N/m
4a. 110 N/m
4d. v(t)=(25)cos(83t)

7a. 0.0038 s
7b. 0.0038 s
10. 4 times
11. 0.04 m
12a. 16 Hz
12b. 16 complete cycles but 32 times up and down, 315 complete cycles but 630 times up and down
12c. 0.063 s
13a. 24.8 J,165 N, 413 m/s^2
13b. 11.1m/s, 0, 0
13c. 6.2 J, 18.6 J, 9.49 m/s, 82.5 N,206 m/s^2
13d. .169 sec, 5.9 Hz
14b. .245 J
14c. 1.40m/s
14d. 1.00 m/s
14f. 2.82 N
14g. 3.10 N

Ch 11: Wave Motion and Sound

1. 390 Hz
2a. 4 Hz
2b. It was being driven near its resonant frequency.
2c. 8 Hz, 12 Hz
2d. (Note that earthquakes rarely shake at more than 6 Hz).
5a. 7 nodes including the 2 at the ends
5b. 3.6 Hz
6. 1.7 km
7a. 1.7 cm
7b. 17 m
8a. 4.3×10^{14} Hz
8b. 2.3×10^{-15} s - man that electron is moving fast
9a. 2.828 m
9b. 3.352 m
9c. L = ¼ λ so it would be difficult to receive the longer wavelengths.
10. Very low frequency
11b. Same as closed at both ends
13. 1.9 Hz or 2.1 Hz.
14. 0.53 m
15. 2.2 m, 36 Hz; 1.1 m, 73 Hz; 0.733 m, 110 Hz; 0.55 m, 146 Hz
16. 430Hz; 1.3×10^3 Hz; 2.1×10^3 Hz; 3.0×10^3 Hz;
17a. The tube closed at one end will have a longer fundamental wavelength and a lower frequency.
17b. If the temperature increases the wavelength will not change, but the frequency will increase accordingly.
18. struck by bullet first .
19. 80 Hz; 0.6 m
20a. 0.457 m
20b. 0.914 m
20c. 1.37 m
21. 2230 Hz; 2780 Hz; 2970 Hz
22. 498 Hz
23. 150 m/s

.

Ch 12: Electricity

11b 1350 N
11c. 1350 N
12a. 1.1 x 10^9 N/C
12b. 9000 N
13. $F_g = 1.0\times10^{-47}$ N and $F_e = 2.3\times10^{-8}$ N. The electric force is 39 orders of magnitudes bigger.
14. 1.0×10^{-4} C
16a. down
16b. Up 16c, 5.5 x 10^{11} m/s^2
16e. 2.9 x 10^8 m/s^2
17a. Toward the object
17b. 3.6 x 10^4 N/C to the left with a force of 2.8 x 10^{-7} N
18. Twice as close to the smaller charge, so 2 m from 12μC charge and 1 m from 3μC charge.
19. 0.293 N and at 42.5°
20. 624 N/C and at an angle of $-22.4°$ from the + *x-axis*.
21a. 7500V
21b. 1.5 m/s
22a. 6.4×10^{-17} N
22b. 1300V
22c. 2.1 x 10^{-16} J
22d. 2.2 x 10^7 m/s
23b. 0.25m
23c. F_T = 0.022N
23d. 0.37 μC

Ch 13: Electric Circuits – Batteries and Resistors

1a. 4.5C
1b. 2.8 x 10^{19} electrons
2a. 0.11 A
2b. 1.0 W
2c. 2.5 x 10^{21} electrons
2d. 3636 W
3a. 192 Ω
3b. 0.42 W
4a. 5.4 V
4b. 1.4 x 10^{-8} A
4c. 7.3 x 10^{-11} W, not a lot
4d. 2.6 x 10^{-7} J
5. left = brighter, right = longer
6a. 224 V
6b. 400 W by 100 Ω and 48 W by 12 Ω
6c. 448 W
7b. 8.3 Ω
8. 0.5A
10. 0.8A and the 50 Ω on the left
11a. 0.94 A
11b. 112 W
11c. 0.35 A
11d. 0.94 A
11e. 50, 45, 75 Ω
11f. dimmer; total resistance increases
11g. 45 Ω
12a. 0.76 A
12b. 7.0 W
13b. 1000 W
14a. lightbulb A
14b. lightbulbs B,C
14c. i. All; ii. C; iii. None
14d. i. A dimmer, D brighter, C out
ii. A dimmer, B,C brighter
15a. 9.1 Ω
15b 29.1 Ω
15c. 10.8 Ω
15d. 26.8 Ω
15e. 1.8A
15f. 21.5V
15g. 19.4V
15h. 6.1V
15i. 0.24A
15j. 16 W hr
16a. 3.66 Ω
16b. 0.36A
16c. 1.32 V
23a. 10V

Ch 14: Magnetism

1. No: if v = 0 then $F = 0$; yes: $F = qE$
4a. Into the page
4b. Down the page
4c. Right
5. Both pointing away from north
8. 7.6 T, south
9. Down the page; 60 N
10a. To the right, 1.88×10^4 N
10b. 91.7 m/s
10c. It should be doubled

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11. East 1.5×10^4 A
12. 0.00016 T; if CCW motion, B is pointed into the ground.
13. 1.2×10^5 V, counterclockwise
14a. 15 V
14b. Counter-clockwise
15a. 2×10^{-5} T
15b. Into the page
15c. 2.8 N/m
15d. CW
16a. 2.42×10^8 m/s
16b. 9.69×10^{-12} N
16c. .0055 m
17. E/B
18a. 8×10^{-7} T
18b. 1.3×10^{-6} C
19a. 0 .8 V
19b. CCW
19c. .064 N
19d. .16 N/C
19e. .13 w
20a. 1.11×10^8 m/s
20b. 9.1×10^{-30} N<< 6.4×10^{-14} N
20d. .00364 T
20e. .173 m
20f. 7.03×10^{16} m/s²
20g. 3.27°
21. 19.2 V
22a. 8.39×10^7 m/s
22b. 2.68×10^{-13} N, -y
22c. 2.95×10^{17} m/s²
22d. .00838 m
22e. 1.68×10^6 N/C
22f. 16,800 V
23a. 1.2×10^{-6} T, +z
23b. 1.5×10^{-17} N, -y
23c. 96 N/C, -y

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Ch 15: Electric Circuits—Capacitors

2a. 4×10^7 V
2b. 4×10^9 J
4a. 100 V
4b. A greater voltage created a stronger electronic field, or because as charges build up they repel each other from the plate.
5. 21 V, V is squared so it doesn't act like problem 4
6a. 3.3 F
6b. 54 Ω
7a. 200 V
7b. 5×10^{-9} F
7c. 2.5×10^{-9} F
8a. 6V
8b. 0.3A
8c. 18V
8d. 3.6×10^{-4}C
8e. 3.2×10^{-3}J
8f. i) 80μF ii) 40μF iii)120μF
9a. 26.7μF
9b. 166.7μF
10a. 9.0×10^3 N/C
10b. 1.4×10^{-15} N
10c. 1.6×10^{15} m/s^2
10d. 3.3×10^{-11} s
10e. 8.9×10^{-7} m
10f. 5.1×10^{-30}

Ch 16: Electric Circuits—Advanced

1a. 4.9×10^{-5} H
1b. -9.8×10^{-5} V
2. Zero
3a. Yes
3b. No
3c. Because they turn current flow on and off.
4a. 0.5 V
4b. 0.05 A
4c. 0.05 A
4d. 5.5 V
4e. 8.25V
4f. 11×
5a. On
5b. On
5c. On, on, off, on, off, off, on, on
6b. 10.9μ F
6c. 195Ω
6d. 169 Ω
6e. 1.39 A
6f. -42°
6g. 115Hz

Ch 17: Light

3. 2200 blue wavelengths
4. 65000 *x*-rays

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5. 6×10^{14} Hz
6. 3.3 m
8b. vacuum & air
8c. 1.96×10^{8} m/s
9. 6.99×10^{-7} m; 5.26×10^{-7} m
12. Absorbs red and green.
13. 25°
15. 33.3°
16a. 49.7°
16b. No such angle
16c. 48.8°
17b. 11.4 m
17c. 11.5 m
18. 85 cm
19c. 4 units
19e. –1
20a. 6 units
20b. bigger; M = 3
21c. 1.5 units
21d. $^2/_3$
22c. 21/4 units
22e. $-\,^2/_3$
23c. 5.3 units
25b. 22.5 mm
27. 32 cm
28a. 10.2°
28b. 27 cm
28c. 20 cm
29a. 0.72 m
31. 54 cm, 44cm, 21 cm, 8.8 cm
33. 13.5°
34. 549 nm

Ch 18: Fluids

1. 0.84
2. 1.4×10^{5} kg
3a. 90% of the berg is underwater
3b. 57%
4b. 5.06 x 10^{-4} N
4c. 7.05 m/s^2
5. 4.14 m/s
6. 40 coins
7b. upward
7c. 4.5 m/s^2
7d. Cooler air outside, so more initial buoyant force
7e. Thin air at high altitudes weighs almost nothing, so little weight displaced.
8a. At a depth of 10 cm, the buoyant force is 2.9 N
8d. The bottom of the cup is 3 cm in radius
9a. 83,000 Pa
9b. 104 N
9c. 110 N
10a. 248 kPa
10b. 591 kPa
10c. 1081 kPa
12. .0081
13a. 12500 J/m^3
13b. 184 kPa
13c. 1.56 kW
13d. 2.57 kW
13e. 11.8 A
13f. $12.6
14a. 611 kPa
14b. 6 atm
15b. 500,000 N
16a. 27 m/s^2, (2.7 g) upward
16b. 1600 N
16c. 2200 N
17a. 10 N
17b. 10.5 N
17c. 11 N
17d. 11 N
18a. "The Thunder Road"
18b. 2.0 m (note: here and below, you may choose differently)
18c. 33.5 m^3
18e. 3.5 million N
18f. 111 MPa

Ch 19: Thermodynamics and Heat Engines

18. 517 m/s
19. 1.15 x 10^{12}K
21. 40 N
22. $\approx 10^{28}$ molecules
23a. 21,000 Pa
23b. Decreases to 61,000 Pa
23c. 5.8 km
24a. No
24b. allowed by highly improbable state. More likely states are more disordered.
25a. 8.34 x 10^{23}
25b. 6.64×10^{-27} kg
25c. 1600 m/s
25d. 744 kPa
25e. 4.2×10^{20} or 0.0007 moles
25g. 0.00785 m^3
26a. 1.9 MW
26b. 0.56 MW
26c. 1.3 Mw
27a. 54%
27b. 240 kW
27c. 890 kW

.

27d. 590 kW
27e. 630 kg
28a. 98%
28b. 4.0%
28c. 12%
29. 14800 J
30. 12,000 J
31b. 720 K, 300 K, 600 K
31c. isochoric; isobaric
31d. C to A; B-C
31e. 0.018 J
32b. 300 K, 1200 K
33a. 1753 J
33b. -120 J
33c. 80 J
33d. 35 J
33e. -100 J, 80 J, 80 J

Ch 20: Special and General Relativity

1. longer
2. $\gamma = \infty$, the universe would be a dot
3. 76.4 m,76.4 m
5. $\gamma = 1.002$
6. 9.15×10^7 m/s
7. 2.6×10^8 m/s
8a. 0.659 km
8b. 22.4
8c. $4.92\text{x}10^{-5}$ m/s
8d. 14.7 km
9. 2900 m
10. $1.34 \text{ x } 10^{-57}$ m
11. 0.303 s
12. $2.9 \text{ x } 10^{-30}$kg, yes harder to accelerate
13a. f
13b. c
14. 4.5×10^{16} J; 1.8×10^{13} softballs
15a. $1.568 \text{ x } 10^{-13}$ J
15b. $3.04 \text{ x } 10^6$ J

Ch 21: Radioactivity and Nuclear Physics

6a. Substance A decays faster than B
6b. Substance B because there is more material left to decay.
7a. ${}^{219}_{88}Ra \rightarrow {}^{215}_{86}Rn + {}^{4}_{2}He$
7b. ${}^{158}_{63}Eu \rightarrow {}^{158}_{64}Gd + {}^{0}_{-1}e^-$
7c. ${}^{53}_{22}Ti \rightarrow {}^{53}_{23}Va + {}^{0}_{-1}e^-$
7d. ${}^{211}_{83}Bi \rightarrow {}^{207}_{81}Tl + {}^{4}_{2}He$
8a. 5×10^{24} atoms
8b. Decay of a lot of atoms in a short period of time
8c. 2.5×10^{24} atoms
8d. ½
8e. 26.6 minutes
9. The one with the short half life, because half life is the rate of decay.
10a. Substance B = 4.6 g and substance A = 0.035 g
10b. substance B
11. 1.2 g
12. 125 g
13. 0.46 minutes
14. t = 144,700 years
15. 0.0155 g
16. 17 years
17. 49,000 years

Ch 22: Standard Model of Particle Physics

1. strange
2. Some type of meson
3. Electron, photon, tau…
4. Neutron, electron neutrino, Z^0
5. Neutron, because it doesn't have electrical charge
6. No, because it doesn't have electrical charge
7. Two anti-up quarks and an anti-down quark
8. Lepton number, and energy/mass conservation
9. Yes, W^+, W^-, because they both have charge
10. The weak force because it can interact with both quarks and leptons
11. Yes; a,b,c,e; no; d,f
12. The standard model makes verifiable predictions, string theory makes few verifiable predictions.

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Ch 23: Feynman Diagrams

1. Allowed: an electron and anti-electron(positron) annihilate to a photon then become an electron and anti-electron(positron) again.

2. Not allowed: electrons don't go backward though time, and charge is not conserved
3. Not allowed: lepton number is not conserved
4a. Allowed: two electrons exchange a photon

4b. Not allowed: neutrinos do not have charge and therefore cannot exchange a photon.
5a. Allowed: an electron and an up quark exchange a photon
5b. Not allowed: lepton number not conserved
6. Not allowed: quark number not conserved
7. Allowed: electron neutrino annihilates with a positron becomes a W^+ then splits to muon and muon neutrino.
8. Allowed: up quark annihilates with anti-up quark becomes Z^0, then becomes a strange quark and anti-strange quark
9. Not allowed: charge not conserved
10. Allowed: this is a very rare interaction

11. Not allowed: electrons don't interact with gluons
12. Not allowed: neutrinos don't interact with photons

13. Allowed: the electron and the positron are exchanging virtual electron/positron pairs
14. Allowed: this is beta decay, a down quark splits into an up quark an electron and an electron neutrino via a W^- particle.
15. Allowed: a muon splits into an muon neutrino, an electron and an electron neutrino via a W^- particle.

Ch 24: Quantum Mechanics

1a. 6.752×10^{-26} J, 2.253×10^{-34} kgm/s
1b. 5.96×10^{-20} J, 1.99×10^{-28} kgm/s
1c. 4.90×10^{-28} J, 1.63×10^{-36} kgm/s
2a. 1.94 ev, 1.04×10^{-27} kgm/s
2b. 12.7 ev, 6.76×10^{-27} kgm/s
2c. 5.00 ev, 2.67×10^{-21} kgm/s
3a. .0827 nm
3b 4.59×10^{-4} nm
3c. .942 nm
4. 1.03×10^{-20} m
5a. 36 nm
5b. no
5c. 380 nm,73 nm,36 nm,92 nm,39 nm
6. .80 V
7. .564 nm
8a. .124 nm
8b. .00120 nm
9. 24,600 m/s
10. 1.84×10^{8} m/s
11a. .491 m/s
11b. $3.14\ 10^{7}$ J
11c. 64 Mw
11d. 1.55 pm
12. 3.27 ev
14b. 15
14c. 182 nm,188 nm, 206 nm,230 nm
15. -10.3 ev,-3.82 ev, -2.29 ev, -1.83 ev
16.a. 4.19×10^{7} m/s
16b. 1.70×10^{-11} m
16c. 1.95^{o}
16d. .068 m
17a. 1.89 V
17b. 1.60 A
17c. 1.25 Ω
18a. 4.40×10^{-24} kgm/s
18b. 1.17×10^{-24} kgm/s
18c. 3.23×10^{-24} kgm/s
18d. 3.76×10^{7} m/s
19a. 1.1365×10^{-22} kgm/s
19b. 5.860 pm
19c. $^{242}Cu \rightarrow {}^{4}He + {}^{238}Pu$
19d. 238.0497 amu
19e. 17.7 cm
19f. –y
19g. +y, 34.2 N/C